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Relations Between Plants and Birds in the Missouri River Region.

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IN making a study of the birds of a small area bordering the Missouri river in northeastern Kansas special attention was given to the recording of facts bearing upon the relations of particular kinds of plants to birds. All observations herein recorded were made within one and one-half miles of the old townsite of Geary, Doniphan county, Kansas, and between 1921 and 1925.

Although it is now generally recognized that the vegetation of a region has an important and well-defined influence upon the bird life of the region, there are few published papers which deal with this phase of bird study. Since so few studies of bird life have been made from this viewpoint, it is thought desirable to record observations somewhat in detail rather than to make general statements without presenting the data on hand which indicate the nature of the relationships that exist between the various kinds of plants and the birds of the region.

Particular plants of this area were found to influence certain birds by furnishing: (1) Suitable nesting sites; (2) food; (3) shelter, resting places, screen; (4) nesting materials.

A brief account of other factors which influence birds in ways similar to plants is added.

INFLUENCE OF IMPORTANT PLANT GENERA.

Acer. Two of the species of larger trees of the area belonged to this genus. The white maple (*Acer saccharinum*) was a common tree where it had been planted in yards and in other places near houses. The trees were usually not crowded so that there was plenty of room for the tops to become large and for large limbs to develop.

A few birds gathered insect food from the branches of the maples. This tree did not furnish especially suitable nesting sites, and only a few species nested in it. One nest of the mourning dove was found thirty feet from the ground on a large sloping limb of a maple. A blue jay's nest was found on a similar limb three inches in diameter. Another was seen building a nest in a crotch made by two limbs and twenty feet from the ground. A third nest of the blue jay was twenty-five feet from the ground. The Baltimore oriole placed nests in the ends of drooping branches. A nest of this species was placed ten feet from the ground. A red-eyed vireo's nest was found hanging from a horizontal fork of a limb three-eighths of an inch in diameter, seven feet from the ground, in a tree forty feet high that was growing on the bar east of the lake. Robins built a nest four feet from the end of a small branch in the top of a maple.

The box elder (*Acer negundo*) was more generally distributed over the area than was the maple. This tree was found in yards, along the road on the lower part of the bluff, along the creek and ravines, and in the older parts of the bar. In addition to the supply of insect food on its leaves and branches, the crop of seeds of this tree furnished some food for winter seed-eating birds such as cedar waxwings. Most individuals of this species were not large. A mourning dove's nest was found ten feet from the ground on a horizontal limb. Yellow-billed cuckoos nested in similar situations. Bronzed grackles were found nesting in the tops of trees of this species that were growing along a creek. A cardinal's nest was found six feet from the ground in a small, bushy box elder. Rose-breasted grosbeaks nested on horizontal limbs ten feet from the ground and in a position similar to that selected by one pair of summer tanagers for a nest site. A red-eyed vireo built a nest nine feet from the ground in a medium-sized tree along the lower part of the bluff. Robins nested in an upright crotch twelve feet from the ground and on a horizontal limb fifteen feet from the ground. Blue jays nested in a crotch near the top of a tree and thirty feet from the ground.

Ambrosia. Several kinds of weeds, including *Ambrosia, Cannabis, Amaranthus, Chenopodium, Melilotus* and *Rumex* grew in dense tangles in patches of waste ground over all the area, and especially in fence rows, roadsides, on waste parts of the bar, in fields that were not well cultivated or that were not planted to crops, and in artificial clearings on the bluff. These dense growths were from

five to ten feet high. During the summer there was some insect food on these plants, but they were of most use to birds in furnishing nest sites. The indigo bunting and dickcissel were common nesters in these weeds. Their nests were usually placed from two to four feet from the ground. Redwinged blackbirds nested in patches of rumex that grew near the lake.

In August and early September these weeds furnished an abundant supply of insect food and many resting places for the smaller species of migrating birds. Some of the more frequent species in these flocks were the orchard oriole, Baltimore oriole, indigo bunting, dickcissel, blue-headed vireo, Bell's vireo, worm-eating warbler, Nashville warbler, orange-crowned warbler, Tennessee warbler, Kentucky warbler, mourning warbler, Maryland yellow-throat, yellow-breasted chat, Wilson's warbler, Canada warbler, catbird, and western house wren.

During the winter months many of the seed-eating birds spent their time feeding on the large crop of seeds produced by these weeds. The species which regularly fed there at this time are: Downy woodpecker, red-winged blackbird, purple finch, goldfinch, pine siskin, Harris' sparrow, white-throated sparrow, tree sparrow, slate-colored junco, song sparrow, Lincoln's sparrow, swamp sparrow, fox sparrow, towhee, cardinal, indigo bunting, English sparrow, mourning dove, and chickadee. The winter wren, golden-crowned kinglet, and ruby-crowned kinglet were sometimes found in the weeds.

Celtis. The hackberry (*Celtis occidentalis*) is not a dominant tree of the region, but it exerts an influence upon the bird life. The larger trees of this region were found in yards and along the creek. Others grew along the bluff and especially along its lower part. In addition to the usual amount of insect food found on the foliage of this tree, there was each year a crop of fruit which ripened in the fall and which was on the tree through the winter. Cedar waxwings and robins were seen feeding on the fruit of this tree.

A nest of the mourning dove was found on a hackberry limb thirty feet from the ground. Orchard orioles nested on the end of a branch fifteen feet from the ground.

Cercis. The redbud (*Cercis canadensis*) is one of the more important of the smaller trees of this region to birds. It is found along the creeks and in sprout fields, and as an invader on the river bluffs. It grows usually as a small, spreading tree with a rounded

top and many branches. In the more crowded situations this tree grows taller and with fewer branches. In this form the tree is less favorable for use by birds than it is when rounded. During the latter half of April redbud trees are in flower, and they attract many small insects, which in turn attract the flocks of small, migrating, insect eating birds, many of which do most of their feeding at about the level of the tops of redbud trees.

Several species of small summer residents found suitable nesting sites in redbud trees. A nest of the mourning dove was found on a leaning main trunk and nine feet from the ground. This tree furnished one of the most favorable nest sites for the yellow-billed cuckoo, five nests being found in the bushy tops from four to twelve feet from the ground. A nest of the cardinal was found in a fork three and one-half feet from the ground. A nest of the yellow-breasted chat was found four feet from the ground on a redbud sprout. A natural cavity, four and one-half feet from the ground, in a main trunk of a redbud, held a nest of a tufted titmouse.

Cornus. The rough-leaved dogwood (*Cornus asperifolia*) was one of the most abundant of the secondary trees, both on the bluff and in the later stages of growth on the bar. Dogwoods were also found growing in the bottom-land timber along the creek. The tree usually grew with a spreading top of many branches that were covered with a thick growth of leaves. These trees were usually not over fifteen feet high.

In addition to the insect food that birds find in the leaves and on the branches of dogwood, there is a large crop of white fruit that ripens in August of each year, and which is a popular food supply for large flocks of birds that gather before and during the first movements toward the south in the fall. This fruit ripens about the last of August and usually hangs on the tree until it is eaten by the birds. Some of the species most often seen feeding on the fruit of dogwood are the kingbird, catbird and brown thrasher. A red-bellied woodpecker was seen picking the fruit, which it ate.

A screech owl was found hiding in the thick tops of a thicket of dogwood that was growing along the lower edge of the bluff.

At least eight species of birds found suitable nesting sites among the branches of the dogwood. Two nests of the yellow-billed cuckoo were found on horizontal branches five and six feet from the ground. Two nests of the cardinal were found in dogwood sprouts, and two nests of the indigo bunting were found in the thick tops of small dogwoods. These nests were well hidden by the leaves. A pair of red-

eyed vireos nested on the end of a limb of dogwood five feet from the ground. Two nests of Bell's vireo were found at the ends of lower branches of dogwoods on the bar and within three feet of the ground. Yellow-breasted chats nested on a dogwood sprout and three feet from the ground. A nest of the brown thrasher was found in the top of a dogwood eight feet from the ground. Two nests of the wood thrush were found in forks of a main trunk seven feet from the ground.

Hicoria. Several species of hickory trees were found in the timber on the bluff. *Hicoria ovata* was the most common of these, and affected the bird life a little more than did the other species. The hickory is one of the largest trees in this region, the size being partly dependent upon the thickness of the soil covering over the rocks and the nearness of other trees. When the trees grow close together the trunks are limbless for several feet, and the tops are small and consist of few branches.

Several species of birds hunted over the trunks and limbs for insect food in winter, and hunted in the leafy branches in summer.

Not many species of birds nested in hickory trees. The larger trees, so far as is known, furnished nesting sites for only two species of birds. Two nests of the ruby-throated hummingbird were found on small horizontal branches twenty feet from the ground. A nest of a pair of scarlet tanagers was found on a larger limb twenty feet from the ground. A nest of the cardinal was found six feet from the ground on a hickory sprout. A pair of red-eyed vireos built a nest near the end of a branch of a sprout and eight feet from the ground.

Juglans. The black walnut is one of the larger trees in the richer portion of ground along the creek, in low places on the bluff, and in yards. When not too crowded this tree produced a large crown with large branches. Some large walnut trees that were dying furnished good perches for woodpeckers and flycatchers and other birds that require exposed perches for considerable periods of time. The large tops furnish feeding grounds for many small species of insect-eating birds during the spring migrations. The walnut prefers rather rich soil, and it usually grows where the soil is sufficiently deep for a large tap root to be sent down.

This tree furnishes poorer nesting facilities than do some of the other kinds of large trees. Mourning dove's nests were found on horizontal limbs ten feet from the ground and twenty-two feet from the ground. A nest of the yellow-billed cuckoo was found on a small lower limb of a walnut that was seven feet from the ground.

Three nests of the Baltimore oriole were located on the ends of walnut limbs at heights of from twelve to thirty feet from the ground. A nest of the dickcissel was four feet from the ground on a walnut sprout. A pair of blue-gray gnat catchers built a nest in the crotch of a small limb twenty feet from the ground. A robin's nest was found on a horizontal limb twenty feet from the ground.

Maclura. The Osage orange, or hedge (*Maclura pomiferum*), is not a native tree in this part of Kansas, but it has been introduced, and it furnishes an excellent protection for many kinds of birds as well as very good nest sites for some. This plant is usually set out in rows to serve as fences to mark the boundaries of fields and pastures. Sometimes it is kept closely cut back, and its growth regulated so that it makes a dense low thicket. Some trees were found growing singly in pastures where they had grown up after escaping from the fences. These trees were usually the center of a small thicket, which was always popular with thicket-inhabiting birds. Most of the Osage-orange trees on the area studied are in fences that have not been trimmed or otherwise disturbed. Most of these fences are along roads, and they have a belt on either side of from ten to twenty feet that has grown up with shrubs and weeds that meet the lower branches of the trees in the fence, and so make the tangle more dense.

In addition to the birds that find food and protection from the wind and predatory animals, there are several species that use these thickets for nesting sites. These nests of the mourning dove were found in Osage-orange trees. A yellow-billed cuckoo's nest was found eight feet from the ground on a horizontal limb of one of these trees. Cardinals nested six feet from the ground in a hedge fence. A pair of Bell's vireos built a nest five feet from the ground on the end of a limb of a tree in a fence. Brown thrashers built a nest five feet from the ground, but in the center of a fence, and near the main trunk of a tree.

Morus. The red mulberry (*Morus rubra*) grew scattered throughout the timber as a small tree which was not important for birds. This tree in summer produces a large crop of soft fruit that is used as food by birds; but the number of trees in this area was small and the trees themselves were not large enough to produce a fruit crop of sufficient size to influence the feeding of many birds. A red-bellied woodpecker was seen hovering at one tree and picking the ripe berries, which it ate.

Mulberry trees seemed to be unsuitable for nesting sites, and only

one nest was found in one. This was a cardinal's nest that was eleven feet from the ground and which was shaded by a vine.

Nelumbo. The chinquapin, or lotus (*Nelumbo lutea*), was an important plant in the stages of the lake when the water was shallow, and it contributed largely to the filling up of the lake. The leaves usually started to grow rather late in the spring, and they could not be seen above the water until about the first of June. The plants grew rapidly, and within a few weeks the large leaves, two feet or more in width, and the stalks, four or five feet high, were grown and the large yellowish-white flowers were produced. Most of the flowers were gone before the end of August. During September the large heads, three to five inches in diameter and containing twenty to forty seeds each, grew and ripened. During the first part of October the plants dried up and died. The material in the stem and leaves was added to the bottom of the lake. This plant grew in large patches that rapidly spread into all parts of the lake where the water was of suitable depth.

The lotus was of value to birds for the food which it produced in the seeds and as a screen for the birds that feed in the shallow water and on the mud. In the winter crows spent a great deal of time at the lake, feeding on the lotus seeds which they picked out of the heads. They obtained these either from the mud at the edge of the lake or from the ice in the lake. Wood ducks that fed in these patches of plants may have eaten some of the seeds. Other birds that were found in the lotus patches, probably because of the need for a screen and possibly because other kinds of food were more abundant there than elsewhere, are: Shoveller, bittern, great blue heron, green heron, sora, coot, Wilson's snipe, solitary sandpiper, spotted sandpiper, killdeer and the Louisiana water thrush. In the fall red-winged blackbirds settled on the stems of this plant to roost and to rest. Spotted sandpipers were a few times seen walking on floating leaves of the lotus.

Platanus. The sycamore (*Platanus occidentalis*) grows in the timber along the creek and near the lower edge of the bluff, both on the bar and on the bluff. The sprouts of this tree are bushy and are suitable for nesting. The medium-sized trees are spindling and have little-spreading limbs, and are not especially desirable for nest locations. The limbs of the larger trees, which grow in places where they are not crowded, are nearly horizontal and some of them are near the ground. These furnish many desirable nest sites.

Two nests of the kingbird were found twelve feet from the ground in sycamores. One was on a horizontal limb and was in a fork next to the main trunk. Nests of the wood pewee were found near the ends of limbs that were twenty-two feet and thirty feet from the ground. A nest of the cardinal was found seven feet from the ground on a horizontal limb of a small sycamore. Indigo buntings nested three feet from the ground on a sycamore sprout. A natural cavity near the ground in a large sycamore near Doniphan lake was used by a nesting pair of prothonotary warblers. Tall sycamore trees along the lower edge of the bluff were favorite singing perches and feeding places for small birds, and especially the parula warbler.

Polygonum. In the early part of the summer of 1923, when the lake was nearly dry, a large part of its bed was covered with a dense growth of smartweed. Later, when the overflow from the river flooded the lake, the smartweed remained and continued to grow until fall, when the plants died, and after the seeds were mature fell into the water. They did not grow in the summer of 1924. In the fall of 1923 several kinds of birds were flushed regularly from the patches of smartweed. Some of them may have been feeding on the seeds of *Polygonum.* The birds most frequently seen were mallard, blue-winged teal, bittern, great blue heron and coot.

Populus. The cottonwood (*Populus deltoides*) was one of the dominant trees on the bar along the river. It was found in varying sizes from very young saplings to trees forty or fifty feet high. Nearly all of the taller trees were along the lower edge of the bluff or along the creek where the soil had not been disturbed for a number of years. Nearly all of the trees of this species were between fifteen and twenty years old and had trunks about eight inches in diameter.

The medium-sized cottonwood trees furnished food and resting places for a large number of species of smaller birds at all seasons. Black-crowned night herons were frequently found roosting, during the day, in the tops of cottonwoods. Various species of hawks used these trees as lookout perches.

This tree was not especially desirable for nesting. Most birds did not find suitable sites in its branches. Green herons nested in a fork twenty feet from the ground. Yellow-billed cuckoos nested near the main trunk on a limb fifteen feet from the ground. Five nests of the crow were found, from ten to twenty feet from the ground, in cottonwood trees on the bar. One of these nests was used for nesting during a second season by a pair of long-eared owls. Car-

dinals nested six feet from the ground in a small cottonwood that had fallen over and whose leaves had dried. Orchard orioles nested in the top of one of these trees. A nest of the indigo bunting was found nine feet from the ground in a cottonwood sapling. The warbling vireo, although no nests were found, preferred and was usually found in the tops of medium-sized cottonwoods on the bar. Bell's vireo nested five feet from the ground in the end of a branch of a small sapling. A nest of brown thrashers was fastened between two trunks of cottonwood at a height of four feet from the ground.

Prunus. A few peach trees were found in the orchards, as well as a few plum and cherry trees. There were a few wild plum and wild cherry trees on the bar and along the roads. These trees were present in too small numbers to have much influence upon the bird life. In the summer most of them bore fruit that attracted birds. A catbird was seen carrying ripe cherries from an orchard.

Brown thrashers built a nest four feet from the ground in the center of a plum thicket. Mourning doves built on a horizontal limb of a peach tree in an orchard.

Pyrus. Apple trees (*Pyrus malus*) were planted in orchards at most of the houses within the area. These trees were nearly all old, and as they had not been trimmed or properly cared for, many of them were dead or dying. The insects that came to the flowers on the trees in the spring attracted many birds, and apple orchards that were not regularly sprayed furnished an abundant supply of insect food throughout the summer. The wild crab-apple trees that grew on the bluff were also good feeding grounds for many small species of birds.

The low and wide-spreading limbs of the apple trees furnished desirable nest sites for several species of birds. Mourning doves nested twelve feet from the ground in an apple tree. A nest of the kingbird was found in a fork twelve feet from the ground. Rose-breasted grosbeaks nested in the center of the crown of an apple tree and about fifteen feet from the ground. A catbird's nest was found nine feet from the ground in the center of a bushy top of a small tree. Robins nested thirteen feet from the ground in the top of an apple tree. Downy woodpeckers and bluebirds nested in holes that had been made by the woodpeckers in the main trunks and large limbs of apple trees.

Quercus. Oak trees of several species (*Quercus rubra, Q. macrocarpa, Q. coccinea,* and *Q. alba*) make up the most abundant and most important trees on the bluff. Oaks were also found along the

creek. Oak sprouts came up in the cut-over fields that were not kept in cultivation. Some of the largest trees on the area were oaks. The size of the tree depended on the nature of the soil as well as the age of the tree. The trees which grow near the outcrops of rock, where the soil is thin, are usually smaller than those that grow in deeper soil. The trees are usually crowded, so that they are tall and have small tops with few branches near the ground. Large numbers of birds find insect food on oak trees, on the leaves in summer and on the trunk and limbs in winter. Blue jays and red-headed woodpeckers ate the acorns that ripened in the fall.

Oaks of all sizes are suitable for nesting, and a large number of species prefer to build their nests in them. A mourning dove was seen building a nest on a horizontal limb of an oak fifteen feet from the ground and fifteen feet from the main trunk. A nest of Cooper's hawk was found thirty feet and another twenty-five feet from the ground. Both were in forks of the main trunks of medium-sized oak trees. A red-tailed hawk's nest was found twenty-five feet from the ground in a fork of an oak tree whose trunk was one foot in diameter at the base. Yellow-billed cuckoos selected a variety of nesting situations in oaks. One nested four and one-half feet from the ground in a sprout. Another nested on a horizontal limb ten feet from the ground. It was five feet from the main trunk. A third nest was found in the top of a tree and twenty feet from the ground. Seven nests of the ruby-throated hummingbird were found saddled on small twigs near the ends of oak limbs and from ten to twenty-five feet from the ground. Two nests of the wood pewee were found on horizontal limbs of oaks that were twenty feet above the ground. A pair of Acadian flycatchers built a nest six feet from the ground in the end of a lower limb of a medium-sized oak. The material in the nest was chiefly staminate flowers of oak. A crow's nest was found twenty feet from the ground in a fork of an oak. Baltimore orioles were seen feeding young in a nest at the end of a limb in the top of a tree thirty-five feet high. A nest of the field sparrow was found three feet from the ground in an oak sprout eight feet high. Cardinals nested five feet from the ground in an oak sprout. Two nests of the summer tanager were found on horizontal limbs about fifteen feet from the ground. A red-eyed vireo's nest was found hanging from the end of a lower limb of an oak and five and one-half feet from the ground. Brown thrashers nested three feet from the ground in a sprout. Tufted titmice nested in a natural cavity in the main trunk of an oak and five and one-half feet from

the ground. Three nests of the blue-gray gnatcatchers were found near the ends of limbs in the tops of oak trees and twenty feet from the ground. A wood thrush's nest was seen eight feet from the ground on a lower horizontal limb.

Trees of this genus furnish much better nest sites than any others that grow on the bluff in this region.

Rhus. Several species of this genus were found in the area. Sumac (*Rhus glabra*) was found frequently as a good-sized shrub, that grew at the edges of the timber on the bluff, in pastures and in clearings in the timber. A large supply of seeds ripened in the fall and stayed on the plant during the winter. Robins and bluebirds were seen feeding on these seeds. The poison ivy (*Rhus toxicodendron*) climbed over the trees in the timber. It also produced a fruit which birds ate.

Yellow-billed cuckoos nested four and one-half feet from the ground in sumac. A pair of indigo buntings nested four feet from the ground in sumac.

A cardinal's nest was found in a vine of poison ivy that was climbing up the trunk of a cottonwood. The nest was nine feet from the ground.

Ribes. Two or more species of gooseberry (*Ribes* sp.) grew as important plants in the secondary layer of vegetation of the timber on the bluff, along the creek, and on the bar. Clumps of these plants growing together often made dense thickets five or six feet high and several feet in diameter. In these, protected by a dense cover of leaves and by the many thorns on the stems, catbirds and brown thrashers nested.

Rosa. Wild rose bushes grew in clumps on the older parts of the bar, in the timber on the bluff, and along the creek. Each clump furnished a good protection because of the many sharp thorns. Sometimes these roses climbed over other plants or objects. A yellow-billed cuckoo nested six feet from the ground in one of these vines. A nest of the cardinal was found five feet from the ground in the top of a rose bush. Yellow-breasted chats nested in wild rose bushes.

Salix. The willows were dominant trees in the early stages in the development of the bar along the river. They normally cover the bars for the first few years after they are formed. Willows, of all sizes from the small saplings to trees thirty or more feet in height, were present on the bar during the period of this study. Several species were present. Some were found in a narrow line along the

creek. Plants of this genus were used by birds for the important activities of nesting, resting, and hunting food more times than were plants of other genera in this area.

Possible reasons for this apparent popularity of the genus Salix are the great number of individuals of this genus on the area and the great variety of form of those plants due to difference in age. Plants of this genus had an influence upon some important activity of at least seventy-one species of birds during the time that these studies were being made. A great number of these birds were seen feeding on the numerous insects that were found on the willows. These feeding birds were especially numerous in the late summer and during the early fall migrations. Some birds were seen picking bagworms from coccoons in winter. Most of the growth of willows on this bar took place during the first fifteen years after the bar was formed. During this time they were being continually thinned. After they stopped growing other trees, especially *Populus*, overtopped them and crowded them out.

Several species of birds, especially flycatchers, used willows as perches where they waited for flying insects to come near. Others rested in the trees. Owls and herons used them in this way.

Willows provided a variety of situations suitable for nesting sites. Mourning doves nested on a dead willow stump that was two feet above the water in the lake. A nest of the yellow-billed cuckoo was found in a similar location, and one was found seven feet from the ground in a living tree. A red-winged blackbird's nest was found in a willow four feet above the water of the lake. Two other nests of this species were five feet from the ground in willows growing on the bar. A pair of orchard orioles built a nest thirteen feet from the ground in the top of a willow. A nest of the Baltimore oriole was seen in the top of a large willow tree. Nests of the cardinals were found in willows three, five, eight and ten feet from the ground. Two nests of the indigo bunting were located in willows, and were about five feet from the ground. Four nests of the Bell's vireo were found that were fastened to the ends of small twigs, from two and one-half to five feet from the ground, in small willow saplings. Yellow warbler's nests were found five and eight feet from the ground in forks of the main trunks of slender willows. Two nests of the yellow-breasted chat were found in forks of small willows two and one-half feet from the ground. A catbird's nest was found in the fork of a small willow tree four feet from the ground. A nest of the wood thrush was fastened fifteen feet from the ground and adjacent

to the main trunk of a willow on the bar. Birds that nested in cavities of dead willows are: Tree swallow, prothonotary warbler, downy woodpecker, western house wren, chicadee, and bluebird.

Sambucus. The elder (*Sambucus canadensis*) was a common shrub in pastures and sprout fields, in thickets at the edge of the timber on the bluff, and was prominent in the secondary layer of shrubs on the bar. It was also found in clearings in the timber and along the roads. This plant produces a rich crop of fruit in late summer, and several kinds of birds fed on it. The berries are dark red and hang in clusters in the tops of the bushes. The bushes were not high, and did not furnish especially good nesting sites for birds, but four smaller species found them suitable.

Acadian flycatchers built a nest, hanging from the end of a branch five feet from the ground. Four nests of the cardinal were found, four to six feet from the ground, which were placed in forks in the centers of the bushes. Indigo buntings nested one and one-half feet from the ground in a small elder. Three nests of the dickcissel were found from two to four feet from the ground in the forks of elder.

Symphoricarpos. The coral berry (*Symphoricarpos orbiculatus*) was a common, small shrub at the edges of the timber, in partial clearings, along roads, and in pastures. It grew in scattered bunches or in small clumps that were from three to five feet high. The stems of the plant are small and tough. The small leaves are close together and make a good screen. Five species of birds nested in these bushes.

A nest of the field sparrow was found one and one-half feet from the ground in a clump of coral berry. Three nests of the cardinal were found from three to four feet from the ground. Three indigo bunting's nests were found that were one, two and two and one-half feet from the ground. A white-eyed vireo's nest was seen that was two feet from the ground. Two nests of the yellow-breasted chat were two and two and one-half feet respectively from the ground.

Typha. The cat-tail (*Typha latifolia*) grew in and around the lake in dense patches that were almost pure stands. The old growth each year did not fall back entirely to the ground, and the new growth was added to make the thicket more dense. This made a good hiding place for the birds usually found in such situations. Birds found an abundance of insect food in patches of cat-tail as well as good cover and, for a few species, good nesting sites. For every use this was one of the more important plant genera on the area. The activities of at least twenty-five species of birds were

found to be related to *Typha*. Grebes, ducks, herons, rails, coots, snipe, sandpipers and water thrushes swam or waded among the cat-tails to feed or to hide. Tree, song, Lincoln's, and swamp sparrows, Maryland yellowthroats, and winter wrens fed or rested among the stems of cat-tail that were out of the water, more frequently in winter and during the migration seasons than in the summer. Purple martins and tree swallows roosted in large numbers in the cat-tail thickets in the fall.

Yellow-headed blackbirds, red-winged blackbirds and prairie-marsh wrens were found nesting among the cat-tails, usually over the water. A few other species may have nested there, or probably will in future seasons if the growth is allowed to continue and accumulate. Most of the species which nested in the cat-tails required some growth from the previous season to help support and hide their nests. The new growth of a single season is not sufficiently dense.

Ulmus. Two species of elm were found—the white elm (*Ulmus americana*) and the slippery elm (*Ulmus fulva*). The white elm is a dominant tree in the timber on the bluff. It is common along the creek, and is found in the farmyards. Under favorable conditions this is one of the largest trees in the area. The trunks, branches and leaves supply an abundance of insect food for many species of birds. The leaves are especially dense and furnish hiding places for birds like the screech owl.

In some of the older elms there were cavities in which several species of birds nested. Six nests of the mourning dove were found from six to thirty feet from the ground in elms. Those near the ground were in smaller trees. One nest of the yellow-billed cuckoo was found ten feet from the ground on a horizontal limb of a small elm. A ruby-throated hummingbird's nest was seen on a small twig of an elm fifteen feet from the ground. Four nests of the blue jay were found in elm trees. One was twelve feet from the ground in a fork near the main trunk. The others were on limbs that were horizontal or nearly horizontal and were from twenty-five to thirty feet from the ground. A crow's nest was found in a fork of the main trunk of a medium-sized elm and twenty-five feet from the ground. A nest of a pair of orchard orioles was placed in the end of a lower limb and seven feet from the ground. Four nests of the cardinal were found in elms. Three of them were in saplings, and were from three to six feet from the ground. The other was in a low, drooping

limb of a large tree, and was within nine feet of the ground. A white-eyed vireo's nest was found one and one-half feet from the ground and hanging from a small twig of a sapling. A small tree had a catbird's nest saddled on a branch next to the main trunk and six feet from the ground. A nest of the blue-gray gnatcatcher was placed twenty-five feet from the ground and was saddled on a small limb near the top of the tree. Three nests of the wood thrush were found on lower limbs of elms. They were all about twelve feet from the ground. A robin nested in an elm and twenty feet from the ground.

Vitis. The wild grape (*Vitis vulpina*) was found as a climber throughout the timbered land on the bluff, along the creek, and on the bar. It also grows along fence rows and roads. By means of tendrils the vine grows over trees, bushes, fences and other objects so that the leaves may reach the light above. The large leaves help to make a dense shade over whatever the vine covers.

Screech owls rested in the dense shade of the grapevine during the day. In late summer and early fall many of these vines bore a heavy crop of fruit, which was eaten by several species of birds. The tendrils and shreds of bark provided materials for nest building for birds, especially the cardinal. The birds that built nests in grape vines are: Yellow-billed cuckoo, cardinal, indigo bunting and the yellow-breasted chat. As a rule the nests were placed in shaded portions of the vines. The grape was the most important vine for the birds of the area.

INFLUENCE OF OTHER ENVIRONMENTAL FACTORS.

BARE GROUND.

Bare ground was found on some of the newly formed islands in the river, along the recently exposed portions of the lake shore, in the roads, in farmyards, and in freshly plowed or burned fields. No birds were found nesting in these situations within the limits of this area. Pelicans and Canada geese rested on the exposed ground in the center of the river. Wading birds, ducks, terns, gulls, herons and swallows were often seen in late summer and early fall resting on the mud at the edge of pools of water in the lake.

Some species of birds chose these patches of bare ground for feeding. Insects were common in those places that were moist, and most of those species of shore birds which rested on the flats also fed there. In the newly ploughed ground there was a supply of insect food, which the Franklin's gull, black tern, crow, red-winged blackbird,

bronzed grackle, cowbird, robin and bluebird hunted at various times. These birds usually fed in flocks. Single birds of those species which nested near houses were frequently seen running over the bare ground of the yards, picking up nest material or food particles. A few species, such as the mourning dove, bobwhite, prairie horned lark, and blue jay habitually fed in the bare parts of the roads in the vicinity.

CUT BANKS.

Cut banks were found along some parts of the roads, where they had been cut by road graders; along the edges of the river; and along the creek. The cuts along the creek were the largest, some of them being over fifty feet high. These high banks were cut through deposits of lœss, and so it was possible for them to be almost vertical.

Birds used these vertical banks chiefly as nest locations. The belted kingfisher, bank swallow and rough-winged swallow nested in holes of their own excavation. Phœbes and Carolina wrens built their nests in shallow cavities in some of the banks.

A few birds used the crevices and nooks of the cuts as roosting places.

OPEN WATER.

An account of the extent and character of the open water of this area has been given in a previous paper* Many species of aquatic birds showed a preference for this part of the habitat in their feeding and resting activities.

BUILDINGS; BRIDGES; POSTS.

An account* has been given of the number and character of the buildings and bridges of the area and of their influence upon bird life by providing suitable nest sites for several species. Nearly every field was fenced and was surrounded with a line of wooden posts. Some of these posts had cavities in which chickadees and bluebirds nested. Many passerine birds used the fence posts as perches where they rested and sang. Occasionally a bird found some insect food on a fence post.

TREES; HOLLOW STUMPS.

The dead remains of trees were found throughout the timber of the area. They were used as perches by many birds, especially those flycatching species which required an unobstructed view of the surrounding air so that they might locate approaching insects. For

* Wilson Bulletin (vol. 40, 1928, pp. 157-177).

other birds such as the robin, cardinal, and brown thrasher, these dead branches were favorite singing perches.

Most of the cavities in the trees were small, so that the birds which nested in them were chiefly limited to the smaller species such as the screech owl, the woodpecker, the titmice, the crested flycatcher, and the bluebird. Carolina wrens nested in the tops of low stumps.

ANIMALS.

Cowbirds were seen in small groups which followed herds of grazing cattle and horses in pastures in their search for food.

BERKELEY, CAL., January 15, 1928.